Quantitative Comparison of Phase Retrieval Methods in In-Line Phase Tomography

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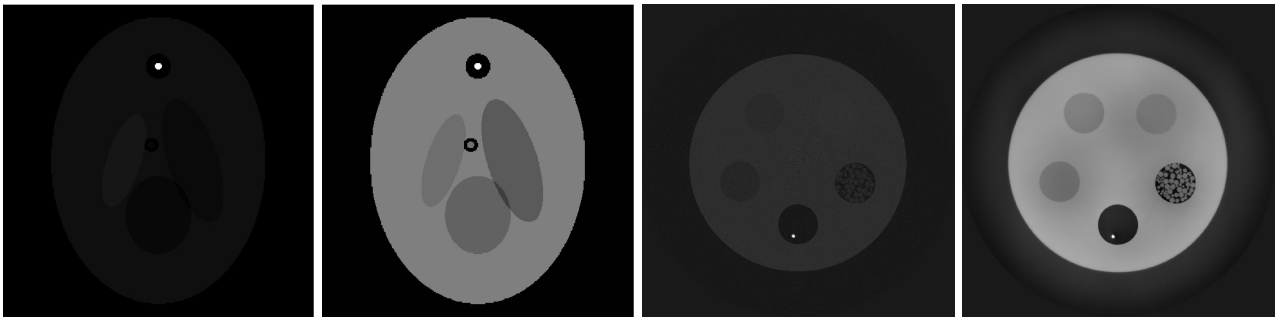
X-ray phase contrast tomography potentially offers several advantages over tomography based on absorption contrast, such as greatly improved sensitivity and lower dose. If the coherence of the X-ray beam is sufficient, a simple mode of phase contrast imaging, based on free space propagation, becomes possible [1]. Phase contrast is achieved by moving the detector downstream of the object and a tomographic scan is then recorded at several sample-to-detector distances. The reconstruction is usually divided into two steps. The phase shift induced by the object is retrieved for each projection angle from the radiographs taken at different distances. This is then used as input to a standard tomographic reconstruction algorithm such as filtered backprojection. This yields a reconstruction of the 3D refractive index distribution in the sample.



(a) (b) (c) (d)

Fig. 1 Phantoms used for evaluation. (a) Simulated absorption and (b) refractive index. Tomographic reconstruction of constructed phantom (c) absorption and (d) refractive index using the Mixed approach.

In this work the quantitativeness of the phase retrieval step for mixed absorption/phase objects in propagation based phase contrast imaging is addressed. Two tests were developed (Fig. 1). First, propagation based imaging was simulated using a mathematically defined phantom. Second, a phantom was constructed from materials of known specification and subsequently imaged using the propagation based phase contrast setup. The simulated and experimental data are then used to evaluate the phase retrieval by comparing the reconstructed to the theoretical values. We consider three phase retrieval methods, the Transport of Intensity Equation [2], Contrast Transfer Function [3] and a Mixed approach [4] between the two. We also present recent improvements of the Mixed approach.

References

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